Effects of habitat change upon the social behavior of captive spider monkeys (*Ateles fusciceps*). D.F. COX and J.A. RUNESTAD. Department of Biology, Western Illinois University, Macomb, Illinois, 61455.

The focus of this study is to examine the effects of environmental change on frequencies of affiliative and agonistic behaviors in captive spider monkeys. A small sample of *Ateles fusciceps* were observed during summer and winter at Henson Robinson Zoo in Springfield, Illinois. During the winter, the group lives in a small, indoor room, while during the summer, the group lives outdoors on an island under more naturalistic conditions.

Focal animal sampling technique was used for data collection. The frequencies of physical contact between individuals was evaluated, as well as the frequencies of allogrooming and possible biting episodes while in contact. The frequency of possible aggressive behavior during noncontact (lip pursing, teeth baring, shoulder raising, and gaping) was also calculated.

Results for the adults indicate that the animals were in physical contact with each other more often in the winter than in the summer (15% versus 5% of observations).

However, a low percentage of the contacts involved allogrooming in the winter than in the summer (16% versus 24%), but this difference was not significant. All possible agonistic behaviors, biting and noncontact aggression, had frequencies below 2% for both winter and summer.

Interpretation of these results will follow more detailed exploration of individual data and other variables.

Stress and mortality in pre-protohistoric samples from central-southern Italy: linear enamel hypoplasia and demographic aspects. A. CUCINA, A. COPPA Università di Roma "La Sapienza", Italy; G. GRUPPIONI, D. MANCINELLI, Università de L'Aquila, Italy

A biologically successful population is the one capable of facing and overpassing environmental impact with. Stress is supposed to be more frequent and more easily scored in those individuals who experienced disease and malnutrition during growth. Moreover, one might generally expect higher frequencies in individuals dying at an earlier age than in those who survived for a longer period. Death is the ultimate indicator of stressful impact, and may provide global evidence of life conditions. Other indicators instead limit to specific periods of the life; one of this is linear enamel hypoplasia (LEH) which is considered as a good stress indicator from archaeological materials. For this reason, a comparison between mortality and LEH is carried out in order to test if stress occurring during the early years of life could affect the individuals' life. These two stress indicators have been analyzed on five pre-protohistoric necropoles from central southern Italy, spanning from the III millennium to the I millennium B.C. The samples analyzed are those of Buccino and Eboli (III millennium B.C.), Alfedena Camerano, Campovalano A, Campovalano B and Tarquinia (I millennium B.C.). LEH has been scored on all teeth available but, in order to have data comparable, only the mandibular canine has been taken into consideration. The number of defects scored on the canine has been put in relationship with age at death for every single individual, and correlation coefficients have been calculated for every population. Then, the mean number of defects for every sample has been correlated with life expectancy at 20 years and frequency of individuals who died after age 50. Individual results indicate that age at death and number of defects are not correlated to each other (values range from -0.480 to +0.118) with an homogeneous distribution of ages at death within each class of number of defects, showing this way that age at death is not affected by how much the individuals had been stressed during childhood. Differently, a stronger correlation can be noted when the global indications of the samples are used. The mean number of defects for each population shows to be negatively correlated to both life expectancy and frequency of death after age 50, with values around -0.900. In conclusion, results show a different pattern when individuals or global data are considered. It is possible to suppose that the global indications provide a more general and indicative trend that gives information about how a population as a whole was capable of responding to the environmental impact.

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Craniodental indicators of body weight in *Galagoides demidovii* and *Tarsius bancanus*. F.P. CUOZZO, University of Colorado, Boulder, CO 80309-0233.

The relationship between body weight and both odontometric and osteometric variables has received much attention in primate evolutionary biology (e.g. Kay 1975; Martin 1980; Gingerich et al. 1982; Dagosto and Terranova 1992). Despite the attention this relationship has received, data concerning intraspecific variation in body weight indicators among small-bodied prosimian taxa are limited. The current study presents data on the relationship between body weight and selected craniodental variables in *Galagoides demidovii* and *Tarsius bancanus*.

Metrical data for five craniodental variables were collected from adult *G. demidovii* and *T. bancanus* skeletal specimens for which body weights were available. A statistical analysis utilizing $\log_e$ transformed data revealed the following: (1) of the five variables tested, bizygomatic breadth exhibits the strongest relationship with body weight for both *G. demidovii* ($n = 15$, $r = .5512$, $p < .05$) and *T. bancanus* ($n = 7$, $r = .6959$, $p < .05$); (2) only in *G. demidovii* is palate breadth related to body weight ($n = 16$, $r = .4328$, $p < .05$); (3) intraspecific correlations with body weight are not indicated for either of the dental variables tested (M_1 length and M_1 length X M_1 width).

These data support Conroy's (1987) observation, based upon research on anthropoid taxa, that intraspecific relationships between body weight and

dental metrics are weak. However, the current study also indicates several tentative intraspecific correlations between body weight and craniometric measures.

The Roles of Gender and Tibetan Ancestry in Ventilation and Ventilatory Hypoxic Responsiveness. L.S. CURRAN and L.G. MOORE, Dept. of Anthropology, University of Colorado-Denver, Denver CO 80217.

It has long been believed that women fare better than men during lifelong high altitude hypoxia. Previous studies also suggest population variation in effects of lifelong hypoxia on ventilation ($\dot{V}E$) and ventilatory control: lifelong male Tibetan residents of 3658 m ventilate more than immigrant male Han ("Chinese") long-term 3658 m residents, and have greater hypoxic ventilatory responses (HVR) than acclimatized Han males who migrated as children. The existence of individuals with mixed Tibetan-Han ancestry (Han-Tibetans, HT) allows testing of hypotheses that *(1)* Tibetan ancestry and *(2)* female gender are advantageous in maintaining high resting $\dot{V}E$ during lifelong hypoxic exposure. We measured male (M) and female (F) HT, born and resident lifelong at 3658 m, for comparison with previously studied M and F Tibetan and Han 3658 m residents. We anticipated values intermediate between Han and Tibetans for $\dot{V}E$ and HVR among HT, and we hypothesized that women's values might differ less than men's across all 3 groups (HT, Tib, Han).

Sample	*n*	*Yrs at 3658 m*	$\dot{V}E/\dot{V}O_2$	$HVR/\dot{V}O_2$	PET_{CO_2}	Sa_{O_2}	*Hb*
HT M	21	26±1	.058±.004	.31±.07	29.9±.6	90.9±.6	18.4±.3
HT F	19	28±1	.054±.004	.37±.07	29.3±.7	91.0±.6	15.6±.3
Tib M	27	23±1	.042±.003	.49±.06	32.2±.6	89.3±.5	17.8±.3
Tib F	13	20±2	.040±.005	.15±.10	30.7±.8	88.8±.7	14.9±.4
Han M	27	9±1	.040±.003	.32±.06	31.6±.5	85.9±.5	18.1±.2
Han F	10	26±2	.039±.005	.34±.11	30.9±.9	86.7±.8	15.2±.5

Comparing groups, HT resemble Tib in having high resting $\dot{V}E$ (corrected for metabolic rate), and resemble Han in having blunted HVR (corrected for metabolic rate). Arterial O_2 saturation (Sa_{O_2}) was likewise higher in HT than in Han or Tib but hemoglobin (Hb) did not differ among the 3 groups. Comparing genders, F had higher effective alveolar ventilation (lower PET_{CO_2}), equal or higher Sa_{O_2}, and lower Hb than M. Maintenance of high alveolar ventilation in F compared with M was not attributable to variation in total $\dot{V}E$ or HVR. Tibetan ancestry thus appears advantageous for preservation of high $\dot{V}E$, and female gender for conserving a pattern of high alveolar ventilation and low Hb independent of population influences. Both hypotheses thus appear to be partially supported.

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Mortuary practices and paleopathological analyses of early northeastern Illinois peoples. M. R. BUZON and A. L. GRAUER, Department of Sociology and Anthropology, Loyola University Chicago, Chicago, IL.

The 1996 excavation of the McGraw Farm Site in Barrington, Illinois yielded the earliest known human remains in northeastern Illinois. A minimum of 17 individuals from eight discrete burial areas were disinterred, ranging in date from 5000 BC (associated with Middle Archaic cultures) to possibly as late as AD 1600 (associated with Late Woodland/Mississippian cultures). This paper examines change and continuity in mortuary practices over time and explores patterns of health and disease in the skeletal sample.

Skeletal remains from the Middle/Late Archaic burial areas indicate that a variety of mortuary behaviors were being practiced simultaneously. These behaviors included inhumation, cremation and secondary "bundling" of the dead deposited within single pit features, as well as multiple inhumations within discrete burial features. The Late Woodland-Mississippian burials appear to yield inhumations exclusively, with most individuals resting on their sides in flexed positions. Ages at death of individuals at the site range from fetal to 50+ years old. Pathological conditions, such as osteoarthritis, trauma, periosteal reaction, porotic hyperostosis, dental caries and enamel hypoplasia are commonly found on the better preserved skeletal and dental material.

Through comparison of this material with other archaeological and skeletal data from contemporaneous sites, a clearer picture emerges of both the unique and consistent nature of this skeletal sample.

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Association between Degenerative Joint Disease of the hands and pottery manufacturing in the prehistoric population of Khok Phanom Di, Thailand. K.M.DOMETT. University of Otago. Dunedin, New Zealand.

Archaeological investigation at the site of Khok Phanom Di, Central Thailand, suggests the people were very prolific potters 3500-4000 years ago. Pottery making implements - anvils and burnishing pebbles - were more commonly associated with the graves of adult females than male or juvenile graves, suggesting that females were carrying out the majority of this work. The hypothesis that there was a sexual division of labour was tested by analysing the distribution of Degenerative Joint Disease (DJD) in the joints of the hands. Joint degeneration can, to some extent, reflect joint use, therefore, differing patterns of degeneration between the sexes may suggest different patterns of hand use. The joints of the hands of 30 skeletons, 15 adults of each sex, with similar mean age at death, were graded for the degree of DJD. They were observed for the presence and degree of porosity and eburnation on the joint surfaces and osteophytic growths around the joint margins. The possibility that the joint degeneration observed in this population is a result of senescence can be excluded as the people of Khok Phanom Di did not have a high life expectancy. The joint degeneration observed here is more likely to be associated with the mechanical use of the joints. Patterns of degeneration were considered between groups of joints and between digits, divided into left and right hands. Significant differences of degeneration implying different patterns of usage were found between the sexes in the proximal interphalangeal joints and the thumb

interphalangeal joint and between the left and right fifth digit of the females. Males consistently showed they were not only more likely to develop joint degeneration but were likely to suffer more severely than females. However, the actual distribution of degeneration in the joints of the hand is what reflects the different activities between the sexes. Males had similar degenerative joint patterns in their left and right hands suggesting they were performing similar activities with both hands. The females had quite different joint degeneration patterns between their left and right hands implying they were using each hand for a different task. This supports the hypothesis that there was sexual division of labour. By considering the ethnographic evidence for the manufacture of pottery and the tools found in prehistory, it is evident that the mechanics of the left and right hands are different in this process. Although it cannot confirm the women in prehistory were the potters this is consistent with the DJD patterns.

Surface strain gradients in alveolar bone. D.J. DAEGLING and J.B. ROSSIE, Department of Anthropology, Yale University, New Haven, CT 06520.

The combined effects of muscular, biting and condylar reaction forces produce bending and twisting stresses *in vivo* in primate mandibles. In addition to their contribution to the bending and twisting moments that occur during mastication, occlusal forces also produce shear stresses in the vicinity of a loaded tooth. How these local stresses are superposed on those attributed to bending and twisting loads is poorly understood.

Both experimental and theoretical work suggest that the mechanical behavior of alveolar bone cannot be adequately characterized by exclusive reference to simple models of the jaw as a bent beam or twisted member. Similarly, given the structurally composite nature of the periodontium, it is unclear whether the local effects of bite forces can be modelled sufficiently by a "shear block" analogy. In effect, we remain ignorant about how to characterize the ways in which masticatory forces are dissipated in alveolar bone.

In this study, we examine surface bone strain from multiple sites inferior to loaded teeth in a sample of wet, fixed human and nonhuman primate mandibles. Under controlled loading conditions, strain was measured from adjacent rectangular (stacked) rosette gages bonded to the alveolar process and surrounding areas of the mandibular corpus. Strain gradients were defined by quantifying differences in shear strain as a function of distance between sampled sites.

The profile of strain gradients is conditioned by numerous factors, including load rate and magnitude, periodontal status and morphology, and variation in bone density. Interaction of these factors in any given situation may preclude the development of fully quantitative models, but a consistency in strain profiles suggests that, subject to certain qualifications, the effects of bite forces can be generalized for comparative applications.

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A preliminary study of the Philippine tarsier (*Tarsius syrichta*) in Leyte. M. DAGOSTO, Northwestern University, Chicago, IL 60611, and D. L. GEBO, Northern Illinois University, DeKalb, IL 60115.

The ecology and behavior of the Philippine tarsier (*Tarsius syrichta*) has never been thoroughly studied in the wild. In May and June of 1997 we initiated a study of the Philippine tarsier on the island of Leyte. Two male tarsiers were captured and radiocollared. We conducted five all-night (dusk-dawn) follows of one tarsier, and four all-night follows of the other. We also spent additional half nights observing these tarsiers. During each of these follows, we marked the location of the tarsier every 15 minutes in order to determine home range and nightly minimum travel distance. Observations were also made on locomotion, substrate use, height, grooming, and feeding.

The tarsiers we observed were always solitary, but calls of other tarsiers were heard on the edges of the home range. The home range of one tarsier was determined to be 0.6 hectares, and 1.7 for the other. Minimum nightly travel distance was 260 meters for one individual and 342 meters for the other. These values are lower than reported for *T. bancanus*, but similar to *T. spectrum*.

Locomotor behavior of the Philippine tarsier is very similar to that of other tarsiers. Leaping made up 62% of locomotor bouts, climbing 23%, and quadrupedalism 13%. Vertical supports were used in 64% of observations, and the majority of supports used were very small (less than 5 cm).

Foraging and traveling took place very low to the ground. 72% of observations were at 2m or less, and 47% less than 1 m. Sleeping sites were all less than 2m off the ground, usually in dense tangles of ferns and saplings or at the base of bamboo clumps.

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Incidence of alveolar bone loss in a nineteenth century, pre-industrial poorhouse cemetery. P.T. DALY, J.E. SIRIANNI, State University of New York, Buffalo.

In 1984 the Monroe County Department of Parks uncovered skeletal remains while expanding a public

facility in Rochester, New York. This cemetery known as the Highland Park Cemetery was excavated by the Rochester Museum of Science. Based on historic records it appears that this cemetery was associated with the Monroe County Poorhouse and was in use from approximately 1826 to 1855.

As part of an ongoing project to assess the health and quality of life of the residents of the poorhouse, this study focuses on the incidence of alveolar bone loss associated with periodontal disease and compares it to the incidence seen in industrilized, twentieth century populations.

A sample of 183 adult skeletons were examined to determine the presence and degree of alveolar bone loss in the maxilla and mandible. Using a method developed by Clark et al. (1986) to assess periodontal disease in modern populations, six measurements were made around each tooth with a calibrated William's probe to determine the degree of bone loss. Measured bone loss was classified into three categories: none or slight, 0-2mm; moderate 2-4mm, and severe >4mm.

Periodontal "pockets" around tooth roots with associated bone resorption was more extensive in the maxillary molar region than in the incisor and premolar regions of both jaws. Approximately 30% of the sample exhibited severe alveolar bone loss in the maxillary molar region. Less than 5% showed bone loss to this degeree in the mandibular molar region. This incidence of severe bone loss was seen in males and females ranging in age from 35 to 60 years. Young females and males showed little or no bone loss in the maxilla and mandible.

Although the overall pattern of alveolar bone loss is similar to that seen in industrialized, twentieth century populations, the degree of severity may be greater.

Postcranial morphometrics of the pygmy marmoset, *Cebuella pygmaea*. L.C. DAVIS, Dept. of Anthropology, Southern Illinois University, Carbondale, IL 62901-4502.

The smallest anthropoid, *Cebuella pygmaea* (120g), is one of the most vertically oriented platyrrhines. Craniodental studies have demonstrated its close relationship to *Callithrix*, prompting the suggestion that *Cebuella* be subsumed under the genus *Callithrix*, although this option has not been widely adopted. This paper addresses the implications of phenetic similarities between the *Cebuella* postcranium and that of other primates of comparable body size and/or shared heritage.

A total of 152 quantitative traits in 13 postcranial bones were compared in *Cebuella* and six callitrichids (*Callithrix jacchus, C. penicillata, Saguinus labiatus, S. geoffroyi, Leontopithecus rosalia*, and *Callimico goeldii*), and one diminutive prosimian, *Microcebus murinus*. Linear variables were standardized for body size. ANOVA and the Tukey-Kramer Test were used to identify which species were significantly different from *Cebuella*. PCA was also performed to examine patterns of similarity between *Cebuella* and the other taxa.

Cebuella exhibited the lowest or nearly lowest mean value for most of the size-corrected traits, indicating it has small features even for a small primate. *Cebuella* is unique in seven features, all located in the knee and ankle. In descending order, *Cebuella* shares the greatest number of traits, though not exclusively, with *C. penicillata, C. jacchus* and *S. geoffroyi, S. labiatus, L. rosalia, M. murinus*, and *Callimico*. Specifically, the *Cebuella* and *C. penicillata* femora are particularly similar. Most pelvic and astragalar features of *Cebuella* and the two *Callithrix* species are also shared. In contrast, many elbow and tibial traits are shared by *Cebuella* and *S. geoffroyi*, to the exclusion of one or both *Callithrix* species. The similarity between *Cebuella* and *S. geoffroyi* (545g) is particularly compelling given their disparate body sizes and known contrasts in their positional repertoires. These results and others suggest that postcranial features of *Cebuella* are not simply those of a diminutive *Callithrix* species. The relative lack of shared traits with *M. murinus* also indicates that the *Cebuella* morphotype is not simply an adaptation to having extremely small body size.

Discussion will focus on possible functional and other explanations for the *Cebuella* postcranial pattern, implications for marmoset and callitrichid taxonomy, and the significance of the exciting newly-discovered marmoset, the black-headed sagui dwarf.

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Economy, nutrition and disease in Southern, Coastal Brazil. V.W. DE AGUIAR and W.A. NEVES, Instituto de Biociências, Universidade de São Paulo, C.P. 11461, 05422.970 São Paulo, SP, Brazil.

The Northern Coast of the State of Santa Catarina, Southern Brazil, was first occupied around 5,000 BP by populations of preceramic shellfishers, which were partially substituted by ceramist groups around 900 AD. Since most Brazilian archaeologists assumes that there is a straight correlation between pottery making and cultivation, these later groups are said to have also introduced agricultural practices in the region. However, this hypothesis has never been directly tested by archaeological means. In this work we test the hypothesis, using for that several osteological markers of quality of life, such as incidence of dental cavities, degree of tooth wear, incidence of linear enamel hypoplasias and porotic hyperostosis in the orbits. None of the markers which are said to increase in frequency with the adoption of agriculture showed higher frequencies in the ceramic level. Consequently, we conclude that although pottery making was introduced in the Northern shore of the State of Santa Catarina by 900 AD, the same cannot be said about agricultural practices. All osteologial markers used seem to point to a very similar lifestyle in both periods.

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Positional Changes in the Frontoparietal Ossification Centers in Perinatal Craniosynostotic Rabbits. **JJ DECHANT, MP MOONEY, GM COOPER, TD SMITH, AM BURROWS, HW LOSKEN, IMJ MATHIJSSEN, MI SIEGEL, University of Pittsburgh, Pittsburgh PA, 15260 and Erasmus Universiteit Rotterdam, The Netherlands.**

It has been suggested that craniosynostosis is caused by abnormally located ossification centers (i.e. bony tubers) in the developing skull prior to suture formation (Mathijssen et al., 1996). The present study was designed to test this hypothesis in a rabbit model of human familial, nonsyndromic coronal suture (CS) synostosis. Calvariae were taken from 99 New Zealand White rabbit perinates (55 normal controls, 15 with delayed onset CS synostosis, and 29 with bilateral or unilateral CS synostosis), ranging in age from 23 to 34 days postconception (synostosis occurs at approximately 23 days in this model). The positions of (i.e., distance between) the frontoparietal, interfrontal, and interparietal ossification centers were obtained using a Wild microscope with camera lucida attachment and a 2-D computer digitization technique. Linear regression analysis was used to compare positional changes in the perinatal ossification centers among groups. Results revealed that frontoparietal ossification center regression line slopes had similar start points (24 day age intercepts) with significantly ($p<0.05$) diverging slopes over time. Normal and delayed onset ossification center distances increased more rapidly than in synostosed perinates. No significant ($p>0.05$) differences were noted in regression line slopes among groups for interparietal or interfrontal ossification center distances. Results demonstrated that in synostosed perinates, frontoparietal ossification center location was similar to normals around the time of synostosis and became displaced later. These findings suggest that ossification center (i.e bony tuber) displacements are probably secondary and compensatory, postsynostotic changes and not primary causal factors of synostosis in this rabbit model. **Supported in part by grants from NIDR (DE010830), Children's Hospital of Pittsburgh, Plastic Surgery Educational Foundation (PSEF), and the Central Research Development Fund (CRDF), University of Pittsburgh.**

Fijian Cannibalism and Mortuary Ritual: Evidence from Vunda. D. DEGUSTA, Laboratory for Human Evolutionary Studies, Department of Integrative Biology, University of California, Berkeley, CA 94720-3140.

The essential identification criteria for prehistoric cannibalism is correspondence between patterns of modifications and disposal of human and (dietary) non-human remains. Food processing behaviors are known to vary between cultures, so the patterns of bone modification and discard may also vary. Currently, the only well-characterized osteological patterning related to cannibalism is from the prehistoric American Southwest. Patterning associated with Fijian cannibalism is assessed here based on an analysis of the remains from the site of Vunda and comparisons with other Fijian sites.

The skeletal sample from Vunda (AD 800--1600) consists of human and non-human bones from a "midden," as well as several human burials from a house mound within the "midden." The excavator's claim of cannibalism was tested by quantifying the modifications of the skeletal specimens. Besides breakage, modifications to the midden human remains are rare (i.e. 1.5% cutmarked, 5.9% burned, no peeling). Such damage is more common in the non-human mammal remains (i.e. 4.1% cutmarked, 8.2% burned, 1.5% peeled). The hypothesis of cannibalism is thus not supported for this assemblage. Instead, it seems likely that some of the "midden" human material really belongs with the burials, and that the damage is largely an incidental result of bodies being placed beneath houses. The data from Vunda can be compared with those from the nearby site of Navatu (where an inference of cannibalism is warranted) to elucidate the osteological patterning related to Fijian cannibalism.

Population data suggests that inter-locus genetic variation at trinucleotide repeats is mutation driven. R. DEKA, Department of Human Genetics, University of Pittsburgh, Pittsburgh, PA 15261, M. KIMMEL, Statistics Department, Rice University, Houston, TX 77005, and R. CHAKRABORTY, Human Genetics Center, University of Texas School of Public Health, Houston, TX 77225.

Among the microsatellite loci, trinucleotide repeats form a special class because over a dozen of them are associated with diseases. Trinucleotides as a whole can be divided into three classes defined by their genomic location and functional attributes, viz., anonymous, gene-associated and disease-causing. We have examined whether the pattern and extent of intra- as well as inter-population variation at these three classes of trinucleotides are different depending on their genomic location. Genotypes were determined in terms of exact repeat numbers at 17 trinucleotide repeats in over 200 individuals belonging to four distinct human populations, viz., German, Nigerian, Chinese and New Guinea Highlander. Selection of these diverse populations allowed us to examine population effects (effective size, evolutionary history) on genetic variation. Our results suggest that the three classes of trinucleotides differ from each other with respect to several features of their genetic variation. With respect to number of alleles, heterozygosity

and allele size variance, the gene-associated loci have the lowest within population variation and the disease-causing loci the highest. The co-efficient of gene diversity (G_{ST}), a measure of the proportion of total genetic diversity attributed to between population differences, is the least for disease-causing loci and is the highest for the gene-associated ones. These observations have several implications with regard to biological features of genetic variation at repeat loci, as well as to their possible causal factors. The reverse relationship of between population variation (G_{ST}) and heterozygosity within populations for the three classes of loci supports a locus-specificity hypothesis. Our study suggests that this pattern of genetic variation can be explained by a mutation driven phenomenon, with the disease-causing loci having the highest mutation rate and the gene-associated ones the lowest mutation rate, and the anonymous being the intermediate.

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Associations between serum leptin, body composition, and maturation from pre- to post-puberty. E.W. DEMERATH, B. TOWNE, W. WISEMANDLE, and R.M. SIERVOGEL. Wright State University School of Medicine, Dayton, OH, 45435.

Although leptin appears to function primarily as a signal between the level of peripheral body fat stores and the central neural control of energy balance (reducing food intake and increasing energy expenditure), recent evidence in rodents and humans (Chehab et al., 1997, *Science* 275:88; Mantzoros, Flier and Rogol, 1997, *J. Clin. Endocrin. & Metab.* 82: 1066) indicates leptin may also be involved in the regulation of sexual maturation.

In this mixed-longitudinal study, we sought to determine whether sex hormone concentration and skeletal maturity made independent contributions to leptin level after adjusting for body fatness. Subjects included 142 participants in the Fels Longitudinal Study (74 males and 68 females) aged 8 to 17 years. Fasting serum leptin, free testosterone, and estradiol were assayed with commercially available test kits, total body fatness (TBF) and fat free mass (FFM) were estimated by hydrodensitometry, and skeletal age was assessed using the Fels Method. A five-stage self-assessed pubertal development score (reduced to three stages for analysis) was obtained at the time of each visit. Leptin was log transformed for all analyses.

Analysis of variance showed 1) that leptin increased three-fold ($p<0.0001$) from pre- to post-puberty in girls, but remained stable in males, 2) that sex differences in leptin concentration arose at puberty ($p<0.001$) and remained thereafter, and 3) a sex-by-age interaction effect ($p<0.0001$). Stepwise regression models of TBF-adjusted leptin on age, FFM, skeletal maturity, estradiol, and testosterone by sex and pubertal stage showed that in males, leptin was negatively associated with testosterone level during puberty (partial $R^2=0.40$). In females, leptin was positively associated with FFM prior to puberty (partial $R^2=0.30$), with skeletal age and estradiol level during puberty (partial $R^2=0.19$ and 0.10, respectively), and with skeletal age after puberty (partial $R^2=0.11$).

These results suggest a secondary role for leptin in the regulation of reproductive and skeletal maturation.

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Takeoff and landing forces of leaping prosimian primates. B. DEMES, W.L. JUNGERS and J.G. FLEAGLE, Dept. of Anatomical Sciences, SUNY at Stony Brook, NY 11794

The morphological variation of primate leapers has been described in great detail. In contrast, the existing data base on the forces leapers generate and absorb is limited in several ways. Here we present takeoff and landing forces for four species of prosimians recorded at the Duke University Primate Center: 3 *Hapalemur griseus* (average body mass 1.0 kg), 2 *Lemur rubriventer* (2.0 kg), 2 *Propithecus verreauxi* (4.0 kg), and 1 subadult *P. diadema* (2.3 kg). Data were collected with a force pole equipped with strain gauges. Leaping distance was standardized at 2 m. Peak forces for over 8 jumps of each species and category are presented in multiples of body weight (bw).

Takeoff and landing forces for *Hapalemur griseus* and *Lemur rubriventer* are virtually identical at around 10 bw for takeoffs and 8 bw for landings. *Propithecus verreauxi* took off with slightly lower peak forces of 9.6 bw and landed with clearly lower forces of only 6.7 bw. The subadult *Propithecus diadema* leapt with the highest forces of almost 14 bw for the takeoff and 9 bw for the landing peaks.

There is no clear size trend in the data. In contrast, phylogenetic and ontogenetic factors seem to be the major sources of variation in this sample. *L. rubriventer*, albeit an adept leaper, is less specialized than *H. griseus* in its locomotor behavior as well as in its body proportions. Hindlimb length relative to body mass is shorter, and leaping kinematics from vertical supports may differ from those of a specialized vertical clinger and leaper, such that higher forces are required to generate appropriate propulsive and braking impulses. The subadult *P. diadema* may leap less efficiently than adult animals. By analogy to human development, reduced mechanical efficiency is known to characterize children's gaits well after they start walking.

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The serine hydroxymethyltransferase pseudogene, SHMT-ps1: A unique marker in the genome of the Order Primates. E.J. DEVOR, University of Iowa, Iowa City, IA 52242.

In the course of a study of evolutionary conservation among members of the serine

hydroxymethyltransferase (SHMT) gene family, evidence of a processed pseudogene (SHMT-ps1) was seen. Human SHMT-ps1 was subsequently cloned, sequenced and mapped to chromosome 1p32.3-p33. It was also added to the evolutionary conservation study. There, it was seen only in the genomes of primates. PCR-based assays of a region of SHMT -ps1 that contains a cofactor recognition site required by the functional members of the gene family were carried out on seven non-mammalian species, fourteen non-primate mammal species and twenty-two primate species. The expected PCR product was observed in all of the primate samples but in none of the non-primate samples. The primates screened with the SHMT-ps1 primers were chimpanzee, gorilla, orangutan, gibbon, several macaque and baboon species, spider monkey, squirrel monkey, tamarin, three capuchin species, and two lemur species. The presence of this fragment in all of these samples indicates that the reverse transcription event that gave rise to the pseudogene must have occurred soon after the divergence of the primates from the rest of Mammalia.

Twelve of the primate PCR products were sequenced and a number of differences in the sequence were seen to be unique to particular species. For example, there is an 11bp deletion that is only in the apes while a complex 30bp duplication/insertion is found only in the vervet monkey.

Several other such phenomena have been found and only 20% of the SHMT-ps1 sequence has been examined. Once completed, the pseudogene SHMT-ps1 will be an extremely useful molecular marker for a range of primate studies.

Infanticide as an extreme form of female reproductive competition in primates and social carnivores. L.J. DIGBY, M.Y. MERRILL & E.T. DAVIS, Biological Anthropology & Anatomy, Duke University, Durham, NC 27708.

Discussions of infanticide in the primate literature typically focus on the killing of dependent infants by unrelated males. But infanticide by female mammals also plays an important role in shaping the social organization and reproductive strategies of a species. This paper focuses on reported cases of infanticide by female primates other than the mother. Information on infanticide in social carnivores is used for comparison and to emphasize the importance of this behavior pattern throughout mammals. Infanticide by non-maternal female primates has been reported in 14 different species, 21 populations (13 wild; 4 semi-free ranging; 4 captive), resulting in more than 33 infant deaths. In carnivores, infanticide by females was observed or strongly suspected under natural condition in at least 6 species. In addition, direct observations of infanticide have been reported in captivity for an 4 carnivore species. Overall, at least 37 carnivore litters suffered losses (in most cases entire litters) from infanticidal females. In both primates and carnivores, cases of infanticide can be categorized into 3 types: direct infanticide (immediate and directed killing of an infant; e.g., *Callithrix jacchus, Lycaon pictus, Mirounga angustirostris*), indirect infanticide (enforced neglect resulting in infants dying of starvation or dehydration; e.g., *Papio* spp., *Speothos venaticus*) and "accidental" infanticide (infants die during attacks on their mothers; *Lemur catta, Eulemur fulvus rufus*). Infanticidal females are almost always the socially dominant female of the group. The killing of young born to subordinates may be reducing resource competition for the perpetrator and her offspring. Indeed, dominant females often directly gain a resource as subordinate females who lose their offspring generally feed the dominant female's infants. Infants may also be used as a food source (cannibalism; e.g., *Pan troglodytes, Panthera leo*). Comparisons across populations and taxa help determine the social and environmental circumstances that make infanticide by females more likely and help characterize the impact these behaviors may be having on the evolution of mammalian social organization and reproductive strategies.

The density of herbaceous vegetation in south-west Central African Republic: implications for western lowland gorilla (*Gorilla gorilla gorilla*) socioecology. D.DORAN and A.MCNEILAGE, Anthropology, SUNY at Stony Brook, NY 11794

Terrestrial herbaceous vegetation (THV) is an important dietary component for gorillas (*G. gorilla*). Variation in its availability and usage has been suggested as an explanation for the differences in African ape social organization. According to Wrangham's (1986) hypothesis, incorporation of THV in the diet reduces feeding competition and allows larger and more cohesive foraging parties to form. This hypothesis assumes that THV of sufficiently high quality is abundant and ubiquitous enough to allow many individuals to feed together. This is generally true for mountain gorillas (*G. g. beringei*). However, recent studies suggest that THV may be less dense and more variable in the lowland forest habitat of western lowland gorillas, than in the montane forests inhabited by mountain gorillas. We document THV density at the Mondika study site in the Parc National Dzanga-Ndoki of C.A.R. as part of a new long term study on the ecology and social organization of western lowland gorillas.

A stratified random sampling method was used to locate sampling plots within each grid cell (250m X 250m) of the study area. All rooted stems of herbaceous

plants of the major gorilla food species were counted and identified in 136 4m² circular plots. Overall densities were low, with less than one stem per m². Several parameters indicated a clumped, patchy distribution of THV, both overall and at the level of individual species. We conclude that THV is not always an abundant, ubiquitous resource in lowland rainforests. Implications for the socioecology of African apes, and particularly for western lowland gorillas are discussed.

Comparison of bone macrostructure and microstructure of exercised and sedentary swine (*Sus scrofa*).
M. S. DRAPEAU, Department of Anthropology, University of Missouri, Columbia, MO 65211

Numerous studies have demonstrated relations between bone macroscopic and microscopic variables and exercise. Many researchers have used these relations to evaluate physical activity levels in past human populations. Greater physical activity increases bone modeling and remodeling, but numerous variables, such as age, sex, genetics, and intensity of activity, appear to influence the modeling and remodeling responses of bone to exercise.

The relation between physical activity and bone morphology was investigated in a sample of Yucatan miniature domestic swine (*Sus scrofa*) (n=61). One group was exercised on treadmills over a period of 14 to 20 weeks, and subjected to increasing speed (3 to 7 mph) and duration of exercise (10 to 75 min.) throughout the experimental period. The control swine were confined to a pen with the exercised swine. Both groups were given the same food and could eat as much as they wanted.

Observed sex differences in bone size indicate that males and females require independent analysis. When controlling for sex, no significant differences in femoral diaphyseal cross-sectional shape or size were observed between the exercised and non-exercised groups.

These results contradict those from other studies of exercised swine. Woo et al. (1981) saw a significant increase in femoral cross-sectional properties with exercise, however their swine were exercised for a full year. These data suggest that the time required for significant amounts of bone deposition to occur might be more than 4 or 5 months. Lieberman and Crompton (1998) found a significant difference in torsional moment of inertia (J) of the femoral midshaft between their two groups. Although their swine were exercised for about the same length of time as those in the present study, they were much younger. Comparison of these results implies that age affects the response of bone to exercise.

It is not clear, at this point, if there is a difference in the delay of the modeling or remodeling response or a net decrease of modeling or remodeling with increase in age. Microscopic study of the femoral cross-sections reveals a small but insignificant difference between the two groups, suggesting that a significant remodeling response to increased exercise might take more than 14 to 20 weeks to occur in swine of with a mean age of 428 days.

Short Tandem Repeats and Ancient Populations: some methodological and interpretive difficulties when working with ancient DNA.
J.C. DUDAR[1], S.R. SAUNDERS[1], J.S. WAYE[2] [1]Department of Anthropology, [2]Department of Cytogenetics, McMaster University, Hamilton, Ontario, L8S 4L9

Ancient DNA (aDNA) investigations have primarily focused on extracting and amplifying mtDNA because of its high copy number and maternal inheritance. A smaller number of studies have pursued analysis of nuclear DNA, frequently for the purpose of detecting single gene disorders, or less often kinship through short tandem repeat (STR) DNA fingerprinting. Difficulties in reproducing amplification products and costs in processing have meant that few studies have generated sufficient sample sizes for population analysis of STR data.

Problems of reliability with STRs used on aDNA have been documented by Ramos et al. (1995) and Zierdt et al. (1996). Ramos and colleagues attribute their atrocious reliability (only one sample generated the same genotype twice) to a high degree of degradation of template DNA. Zierdt and associates (1996) fared only slightly better, with three samples generating the same genotype consistently. They concluded that the scarcity of intact template DNA led to unequal amplification of alleles. Both studies attempted to reconcile this problem by using a "concensus allele" approach whereby an allele detected more than once out of many reactions (up to seven) can be considered as present in the individual and not abnormally generated. This is not a true resolution of the problem, nor an acceptable option when research budgets are a consideration.

We propose a fundamentally better solution to the reliability issue by initially acquiring more aDNA template at the extraction step. By slightly increasing the amount of bone tissue submitted to extraction reagents, and concentrating the lysis solution before removal of inhibitors with silica suspensions or columns (see Yang et al. 1997 for an excellent protocol), we have initially increased allelic reliability to 70%. This improved approach has also yielded sufficient template DNA for multiplex systems, allowing a more cost effective way to collect ancient population STR data.

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Using cranial vault thickness to estimate age in fetal skeletons.
W.N. DUNCAN, Department of Anthropology, Southern Illinois University, Carbondale IL, 62901.

Much of the research addressing fetal age estimation has produced methods that require the preservation of complete bones, such as estimation based on long bone diaphyseal length

(e.g., Fazekas and Kosa 1978). However, the high organic content of the fetal skeletons makes preservation of the entire bones in the archaeological record unlikely. Thus, there are a dearth of fetal age estimation techniques that can be applied to archaeological contexts. The present study is an attempt to provide a method of estimating fetal age based on cranial vault thickness at the ossification centers of the frontal, parietal, and occipital bones, building on Ohtsuki's (1977) preliminary work.

The materials for the present study consist of fetal and perinatal skeletons of known population and sex from the Hrdlička collection and Arikara skeletons from the Smithsonian Institution and the University of Tennessee at Knoxville.

For all of the skeletons, age was estimated by femoral diaphyseal length. The Hrdlička skeletons were used to construct a least squares regression formula. The formula was then tested on the Arikara skeletons. Preliminary analysis suggests that there is a significant relationship between cranial vault thickness and age among fetal and perinatal individuals. Further, no significant differences appear to be attributable to bilateral asymmetry, sex, or population differences.

Variation in bifidity of cervical spinous processes: potential forensic applications. S.M. DURAY and H.B. MORTER, Department of Anatomy, Palmer College of Chiropractic, 1000 Brady Street, Davenport, IA 52803, and F.J. SMITH, Wayne College, Orrville, OH 44667.

Determination of biological ancestry is an important step in the identification of individuals in forensic cases. Ancestry is most commonly assessed using cranial traits. Few reliable postcranial indicators are known. Variation in bifidity of cervical spinous processes was first examined by Cunningham (1886), but sample size was small (N=38), and sex differences were not taken into account. In this study, the frequency of bifidity of cervical spinous processes at different vertebral levels was examined in a sample of 359 Americans of African (Black) and European (White) descent. The sample was selected from the Hamann-Todd collection, a large modern anatomical collection of known sex and ethnicity. Spinous processes were classified as "bifid", "partially bifid", or "nonbifid" based on previously defined criteria. Sex and ethnicity were kept entirely unknown to the classifier (S.M.D.) during data collection. At C2, most individuals (91%) had bifid spinous processes. At C7, nearly all (98%) had nonbifid spinous processes. Significant differences between ethnicity/sex subgroups were found at C3-C6. At each of these levels, whites showed a higher frequency of bifidity than blacks and males a higher frequency of bifidity than females. Differences between ethnic groups were greater than differences within ethnic groups. Pending further study, morphology of the cervical spinous processes may provide an additional method for the determination of ancestry in skeletal forensic cases.

The cranial base of the Ngandong hominids: Implications for modern human origins. A. C. DURBAND, Department of Anthropology, University of Tennessee, Knoxville, TN 37996-0720.

The hominids from the site of Ngandong in Central Java have been the subject of a great deal of controversy since their discovery in the 1930s. These fossils have been alternately viewed either as intermediate between earlier *Homo erectus* and modern Australian Aborigines or a late surviving group of *Homo erectus* that was replaced. To test these hypotheses, casts of the cranial bases present in the Ngandong sample were compared to a large sample of modern crania from Australasia. In addition, the modern Australasian sample was compared to an additional sample of modern African crania to examine the alternate theory of a single origin for modern humans.

Thirty morphological characteristics of the cranial base were examined in the Ngandong crania (predominantly skulls VII and XII), 42 modern Australasian crania, and 9 modern Africans. This investigation revealed a very high degree of phenetic similarity between the modern human samples to the exclusion of the fossils. In particular, the morphology of the temporal bone in the Ngandong sample retained a plethora of more primitive features and bore no resemblance to the modern human morphology.

Craniometrics from the cranial base region were also examined. Univariate and multivariate statistical methods were used to compare the Ngandong crania and two large samples of modern humans from Australasia (n=193) and Africa (n=182). These tests revealed a high degree of homogeneity in the modern sample that did not extend to the Ngandong fossils. The two samples of modern crania shared similar measurements and consistently grouped together in every analysis, while the Javan fossils demonstrated no similarities to either modern group.

These tests suggest that the Ngandong hominids share no special relationship with the modern humans from Australasia. Instead, a single origin for modern humans is indicated by this research.

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